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Forest Insect and Disease Management

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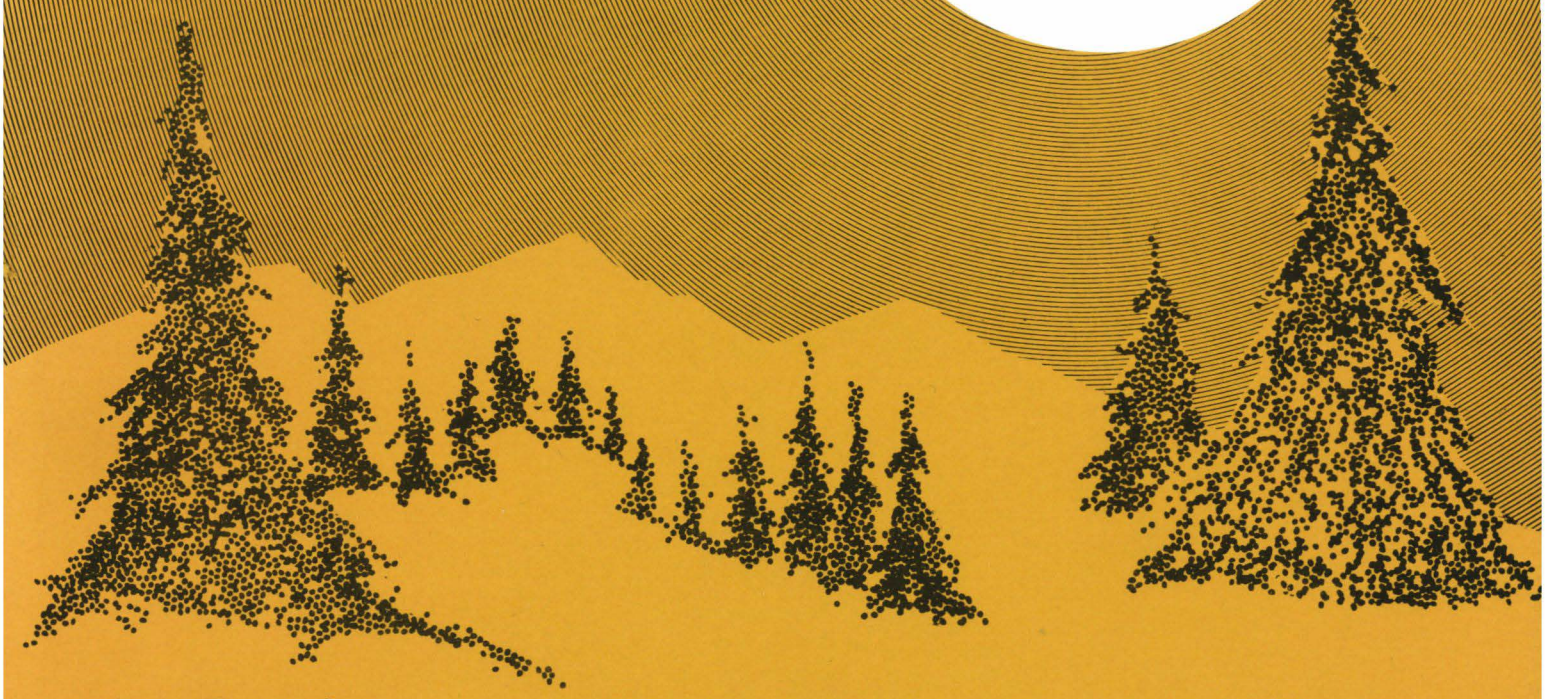
BIOLOGICAL
EVALUATION R2-79-10

Western Tent Caterpillar
Pagosa Ranger District
San Juan National Forest

AUGUST 1979



Rocky Mountain Region

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Western Tent Caterpillar
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AUGUST 1979

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INTRODUCTION

The western tent caterpillar, *Malacosoma californicum* (Packard), has been responsible for severe defoliation of aspen, *Populus tremuloides* Michx., on the Pagosa Ranger District in the vicinity of V-Rocky south to Price Lakes. Tent caterpillar populations have been epidemic in the area since 1976. In 1977, approximately 7,500 acres of aspen were defoliated. The outbreak was first evaluated by Forest Insect and Disease Management (FI&DM) in 1977 (Linnane, Biological Evaluation R2-77-20). Permanent sample plots were established during the initial evaluation. FI&DM continued to monitor the outbreak in 1978 and established additional permanent sample plots. In 1978, the outbreak area enlarged to approximately 12,000 acres and aspen continued to be completely defoliated. In July of 1979, the outbreak area was aerially mapped and determined to include approximately 16,000 acres of federal and private lands (map attached).

At the request of the San Juan National Forest, Jim Linnane, entomologist with FI&DM, conducted an egg mass survey within the outbreak area during the week of August 6. Based on this survey, tent caterpillar populations are predicted to again cause severe defoliation to aspen. This outbreak has resulted in top kill and branch dieback to approximately 5-10% of the aspen stems in the most severely infested areas. Radial growth and height growth, particularly in seedling and sapling size trees, appear to be severely reduced.

BIOLOGY OF THE WESTERN TENT CATERPILLAR

The western tent caterpillar has one generation annually. In aspen stands, adult moths may be found from mid-July to early August. Adults mate shortly after emergence. Females usually deposit one egg mass on small twigs and branches in the upper crown. Embryonic development is completed within four weeks. The insect overwinters as a completely developed first stage larva within the egg. Larvae emerge in the spring about the same time as aspen bud burst. Young larvae feed gregariously. Larvae from the same egg mass or a nearby egg mass construct a silken tent in a branch crotch. This tent serves as a resting place, a moulting site, and for protection during unfavorable climatic conditions. Larvae undergo five molts and mature in 30 to 42 days. Older larvae lose their gregarious behavior and wander indiscriminately

on the host, adjacent vegetation, or the ground seeking additional food or pupation sites. Larvae spin individual silken coccoons in which they pupate. Moths emerge in 12 to 18 days.

Tent caterpillar populations probably reach epidemic proportions for a variety of reasons including favorable climatic conditions for the insect, unfavorable climatic conditions for natural control agents, changes in the host physiology (food quality) which improve insect vigor and fecundity, and genetic variations in insect populations invading uninfested areas. Conversely, tent caterpillar populations decline due to increased pressure from natural control agents, principally viral disease, unfavorable climatic conditions, and reduced vigor due to a decline in food (host) quality and quantity. The predictability of any of the above factors is difficult at best.

EXTENT OF THE OUTBREAK

Aspen defoliation is evident from the vicinity of V-Rock south to Navajo Peak and Price Lakes at an elevation of 8,500 to 9,500 feet. The attached map illustrates the outbreak area. Defoliated aspen was mapped from the air in July 1979. Currently the outbreak encompasses approximately 16,000 acres of federal and private lands.

STAND CONDITIONS

Stands within the outbreak area are predominantly aspen and aspen-white fir type. A considerable volume of aspen is in the saw-timber size class. There are numerous three to six year old regeneration blocks within the infestation area. The aspen component has been defoliated from two to four consecutive seasons since 1976.

Stelzer (1968), reporting on a tent caterpillar outbreak on the Carson National Forest, New Mexico during 1961-1965, found after four consecutive years of defoliation, 85-100 percent of the living aspen in some stands were top-killed. He reported 11 to 52 percent aspen mortality in the same stands.

In Minnesota, Duncan and Hodson (1958) studied the effects of forest tent caterpillar (*Malacosoma disstria* Hbn.) defoliation on aspen. They found no mortality resulting directly from defoliation or from more intensive insect and disease attack following defoliation. The greatest loss appeared as growth reduction which was as high as 90% during the defoliation period and about 15% the following year. A second study (Churchill C.B. et al. 1964) was conducted in the same outbreak area six years after the conclusion of Duncan's and Hodson's work. This study indicated increased mortality in other than suppressed trees with increased defoliation intensity. Increased pathogen (*Fomes*, *Hypoxylon*, and *Nectria*), insect (principally wood borers), wind, and mechanical damage accounted for approximately 30% tree mortality in the 6-10 years following the tent caterpillar outbreak. The evidence indicated tree mortality was caused, at least indirectly, by forest tent caterpillar feeding.

The amount of top-kill and mortality expected from the current Pagosa outbreak is impossible to predict accurately. However, approximately 5 to 10 percent top-kill is already evident in the most severely infested portions of the outbreak.

Radial growth and height growth (particularly in seedlings) are severely impacted. Stelzer (1968) reports a 74.6 percent reduction in aspen radial growth after three consecutive years of defoliation. Radial growth losses in the Pagosa outbreak may translate to a substantial volume loss over a several year period. Although not a factor in sawtimber size trees, height growth in seedling aspen has been substantially reduced within the Pagosa outbreak. Observations in July of 1979 estimated a 60-75 percent loss in height growth for completely defoliated aspen seedlings compared to lightly defoliated seedlings.

EVALUATION METHODS

Egg mass densities are the principal tool in predicting defoliation by the western tent caterpillar. Two 30-inch branches are pruned from the upper crown of each sample tree. The average number of egg masses for the two branch sample is calculated. Egg mass densities per tree are tallied, and a mean egg mass density based on all sample trees is computed. Defoliation predictions are based on a minimum of 20 sample trees.

In 1977 and 1978, FI&DM established eight, 1/10 acre sample plots within the outbreak area. Egg mass densities and subsequent defoliation estimates were determined for these plots in an effort to improve the accuracy of defoliation predictions. In 1979, additional trees were sampled outside the 1/10 acre plots to improve the estimate of egg mass density.

RESULTS AND DISCUSSION

A summary of sampling results for the years 1977 through 1979 is presented in Table 1. During 1977 and 1978, an average egg mass density of 2.84 and 1.97 respectively resulted in heavy (crown completely stripped) defoliation in the 1/10 acre plots and in the surrounding stand. The 1979 samples produced an egg mass density of 2.40. A comparison of sample means for 1977, 1978, and 1979 produced no significant differences (Table 2). Defoliation in the spring and summer of 1980 is predicted to be heavy.

Viral disease, the most effective natural control agent, was not observed in larvae examined during 1979. Natural controls will eventually suppress the outbreak. However, heavy defoliation may continue for 1 to 2 or more years before this event occurs.

At present, damage in terms of top-kill, growth loss, and tree mortality sustained by aspen within the outbreak area is not noticeably severe. Continued defoliation will increase the amount of damage. Neither the number of years remaining in this tent caterpillar outbreak nor the total amount of damage caused by the outbreak can be accurately estimated beyond what has been referenced previously.

ALTERNATIVE ACTIONS

Alternative 1 - Take no action.

This alternative allows the tent caterpillar outbreak to run its' course. Natural controls will eventually suppress the caterpillar population. It assumes damage to the aspen stand is tolerable. Total damage to the stand can be measured and recorded for future reference.

Table 1. A Summary of Western Tent Caterpillar Egg Mass Sampling on the Pagosa Ranger District during 1977 through 1979.

	Year of Oviposition		
	77	78	79
No. Trees Sampled	34	37	88
Total No. Egg Masses Discovered	192	147	422
Average No. Egg Masses per Two 30-in. Branches	2.84	1.97	2.40
Standard Deviation	2.79	2.46	2.41
Standard Error	0.47	0.47	0.25
Defoliation Observed	Heavy	Heavy	Heavy

Table 2. Summary of Student's t-Test for Sample Means for Years 1977 to 1979.

Year	No. Samples	Egg Mass Density ($\bar{x}$)	Degrees Freedom	Computed t-value	Table t value @ 0.05	Significance
77	34	2.84	69	0.0377	2.000	N.S.
78	37	1.97				
77	34	2.84	120	0.1303	1.980	N.S.
79	88	2.40				
78	37	1.97	123	1.0487	1.980	N.S.
79	88	2.40				

Alternative 2 - Suppress the outbreak with an aerial application of chemical insecticide.

Several chemical insecticides (carbaryl, diazinon, acephate) are registered for use against the western tent caterpillar. An aerial application of a chemical pesticide may cost $6-8 per acre. Applied properly, an insecticide application should substantially reduce defoliation without excessive environmental risk. Natural control agents, principally parasites and predators, may also be substantially reduced.

Alternative 3 - Suppress the outbreak with an aerial application of the microbial *Bacillus thuringiensis*.

Several formulations of *Bacillus thuringiensis* (B.t.) are registered for use against the western tent caterpillar. An aerial application of B.t. should substantially reduce defoliation without environmental risk. B.t. is only toxic to insects in the order Lepidoptera (butterflys and moths). An aerial application of B.t. may cost $8 to $10 per acre, slightly more than a chemical insecticide.

Alternative 4 - Assist FI&DM in establishing a pilot project in the Pagosa outbreak to determine losses in the aspen type as a result of the tent caterpillar epidemic and effectiveness of aerial applications of insecticides in reducing or preventing loss in aspen.

This alternative would allow establishment of several test blocks (possibly several hundred acres in size) within the outbreak. Certain blocks would be treated and others would remain untreated. Actual losses in aspen would be determined and efficacy of aerial treatments would be evaluated.

RECOMMENDATIONS

Management objectives, timber values, and aesthetic values should be evaluated for the outbreak area. If these objectives and values are determined to be in jeopardy as a result of tent caterpillar damage and if such objectives and values can justify the expense of a suppression program, we recommend Alternative 3,

suppress the outbreak with an aerial application of the microbial insecticide B.t. The environmental risk of this alternative would be nearly non-existent and efficacy should be adequate for good foliage protection.

Alternative 4, assist FI&DM in establishing a pilot project to evaluate insect damage and suppression strategies, may be considered should the Forest determine management objectives and values do not warrant suppression or should this alternative not unduly interfere with management objectives. The effects of defoliation on the growth and survival of aspen is not well documented in the southwest. A pilot project, as described briefly in alternative 4, would provide such information as well as determining the effectiveness of current suppression strategies in preventing these losses.

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WESTERN TENT CATERPILLAR
PAGOSA RANGER DISTRICT
1979

LEGEND

Outbreak Area

MILES